

**IN THE DRAWINGS:**

Attached is a Submission of Replacement Drawing Sheets including a change to each of Figs. 3, 11-13 and 15. These Replacement Drawing Sheets, which include all of Figs. 1-21 in this application, replace the previously-filed drawing sheets. In these Replacement Drawing Sheets, Figs. 3, 11-13 and 15 have been amended to include the legend "PRIOR ART" in response to the objection to the drawings in the Office Action.

**REMARKS****Summary of the Office Action**

The drawings stand objected to because figures 3, 11-13 and 15 allegedly should be designated by a legend such as "Prior Art."

Claims 7 and 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over what the Examiner refers to as "Applicant's Admitted Prior Art" (hereinafter "AAPA") and further in view of Dapkus (U.S. Patent No. 6,621,842) (hereinafter "Dapkus").

**Summary of the Response to the Office Action**

Applicants have added new dependent claim 10 to differently describe embodiments of the disclosure of the instant application. Accordingly, claims 1-10 are currently pending with claims 7, 8 and 10 currently under consideration and claims 1-6 and 9 currently withdrawn from consideration. Also, a Submission of Replacement Drawing Sheets is concurrently filed incorporating an amendment to each of Figs. 3, 11-13 and 15.

**Objection to the Drawings**

The drawings are objected to because figures 3, 11-13 and 15 allegedly should be designated by a legend such as "Prior Art". In the Submission of Replacement Drawing Sheets filed concurrently herewith, Applicants have amended the drawings by labeling each of Figs. 3, 11-13 and 15 as "Prior Art" in response to the drawing objection. Accordingly, Applicants respectfully request that the objections to the drawings be withdrawn.

**Rejections under 35 U.S.C. § 103(a)**

Claims 7 and 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over AAPA and further in view of Dapkus. These rejections are respectfully traversed for at least the following reasons.

Applicants respectfully submit that the applied Fig. 11 of AAPA illustrates a prior art configuration of a quantum cascade laser (QCL). However, as conceded to by the Examiner at page 3 of the Office Action, AAPA does not disclose “adding N to the quantum well layer composition.” However, the Examiner goes on to allege that Fig. 3 and column/lines 7/30-65 of Dapkus is an example of a teaching supporting the Examiner’s assertion that “semiconductor materials with Nitrogen as the group V elements are well known in the art.”

Applicants respectfully submit that the above-discussed difference between Fig. 11 of AAPA and the advantageous combination of features described in independent claim 7 is significant. More specifically, as described at paragraph [0133] of the instant application’s specification, “it is important that the quantum well layers of active layer 51 comprise GaInNAs,” and since “the quantum well light emitting layers and injection layers that form a cascade structure are formed using group III-V compound semiconductors that contain N, the effective refractive index of active layer 51 is higher than those of GaAs substrate 50 and waveguide clad layer 52 (emphasis added).”

Applicants respectfully submit that by using the above-described configuration, as described in the combination of features described in independent claim 7 of the instant application, for example, very advantageous results are achieved that are neither shown nor suggested by the applied art of record. For example, the specification explains that as

a result of the advantageous combination of features of independent claim 7, “active layer 51 has, in addition to the function of generating light, the function of a waveguide core layer that guides the generated light.” Thus, Applicants respectfully submit that since “the layer thickness above GaAs substrate 50 is thus thinned and the element resistance is made small, self heating of the element is reduced (emphasis added).” In addition, Applicants respectfully submit that in the QCL described in independent claim 7 of the instant application, for example, “since only transitions between conduction band subbands are used, GaInNAs of a region of lattice matching with GaAs can be used (emphasis added).” As a result, the QCL “can be provided with even better crystallinity.” See, for example, paragraphs [0144] to [0147] of the specification of the instant application.

Even further, Applicants respectfully submit that the specification teaches that “with a quantum cascade laser, the shortest emission wavelength that can be achieved is dependent on the intrinsic conduction band discontinuity ( $\Delta E_c$ ) of the material” and, as shown in Figs. 15 and 16 of the instant application, by using the above-described combination of features of independent claim 7, for example, a “shortening of the emission wavelength is enabled with the arrangement of laser.”

Specifically, it is described in the specification that if “half of this  $\Delta E_c$  is presumed to be used in intersubband transitions, light  $h\nu_2$  of a wavelength of approximately 4  $\mu\text{m}$  is generated, thus far surpassing the short wavelength limit of 8  $\mu\text{m}$  of the prior art.” See, for example, paragraphs [0152] to [0154] of the specification of the instant application.

Accordingly, the specification of the instant application has numerous explanations of how the advantageous combination of features described in independent claim 7 of the instant application provides significant advantages over prior art arrangements such as the applied AAPA Fig. 11 arrangement.

Applicants respectfully traverse the Office Action's assertion that, despite the Examiner's concession that AAPA does not disclose "adding N to the quantum well layer composition," the Examiner goes on to allege that Fig. 3 and column/lines 7/30-65 of Dapkus is an example of a teaching supporting the Examiner's assertion that "semiconductor materials with Nitrogen as the group V elements are well known in the art."

Applicants respectfully traverse such an assertion at least because the VCSEL structure of Dapkus is particularly different from the QCL structure of the applied Fig. 11 of the instant application. As a result, Applicants respectfully submit for the record that one having ordinary skill in this art would not be led to make the Office Action's asserted combination at least because of the significantly different laser device structure disclosed in Dapkus as compared to the structure disclosed in the applied AAPA.

More particularly, Applicants respectfully submit that in the laser device structure of Dapkus, a GaAsN/GaAsSb quantum well structure is used in the active layer of a GaAs-based VCSEL structure for realizing a staggered band alignment of a type II band structure. Applicants respectfully submit that this feature is completely different from the previously-described technical features of the advantageous combination of features of independent claim 7 of the instant application. In addition, Applicants respectfully

submit that Dapkus describes that in its disclosed type II band structure, electrons and holes of carriers are confined in adjacent layers to one another. See, for example, col. 4, lines 31-57, col. 6, lines 47-64 and Fig. 3 of Dapkus.

Applicants respectfully submit that such an arrangement is particularly different from the quantum cascade laser as described in the advantageous combination of features of claim 7 of the instant application which is a unipolar laser device that makes use of intersubband transitions of electrons. As a result, Applicants respectfully submit that the laser device described in the combination of features of independent claim 7 of the instant application is directed to an entirely different technical field of laser devices from that disclosed in Dapkus. Accordingly, Applicants respectfully traverse the rejection under 35 U.S.C. § 103(a) as being improper at least because of these technical differences between the Dapkus arrangement and the quantum cascade laser of independent claim 7 of the instant application.

Accordingly, Applicants respectfully assert that the rejections under 35 U.S.C. § 103(a) should be withdrawn because neither of AAPA nor Dapkus whether taken separately or in combination together, teaches, or even suggests, the advantageous combination of features of independent claim 7 of the instant application, for at least the foregoing reasons. As pointed out in MPEP § 2131, "[t]o anticipate a claim, the reference must teach every element of the claim." Thus, "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. Verdegaal Bros. v. Union Oil Co. Of California, 2 USPQ 2d 1051, 1053 (Fed. Cir. 1987)." Also, MPEP § 2143.03 instructs that "[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be

taught or suggested by the prior art. In re Royka, 409 F.2d 981, 180 USPQ 580 (CCPA 1974).” Accordingly, Applicants respectfully submit that independent claim 7 is in condition for allowance.

Furthermore, Applicants respectfully assert that dependent claim 8 and newly-added dependent claim 10 are allowable at least because of their dependence from independent claim 1, and the reasons set forth above. For example, the Examiner asserts, at page 2 of the Office Action, that Fig. 11 of the instant application shows “an active layer [83], disposed on said semiconductor substrate [80].” Such an assertion is respectfully traversed because Fig. 11 shows waveguide clad layer 81 and waveguide core layer 82 disposed between the semiconductor substrate 80 and the active layer 83. Applicants have added a new dependent claim 10 to describe “an active layer is disposed directly on the substrate.”

### **CONCLUSION**

In view of the foregoing, Applicants submit that the pending claims are in condition for allowance, and respectfully request reconsideration and timely allowance of the pending claims. Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicants’ undersigned representative to expedite prosecution. A favorable action is awaited.

**EXCEPT** for issue fees payable under 37 C.F.R. § 1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application including fees due under 37 C.F.R. § 1.16 and 1.17 which may be

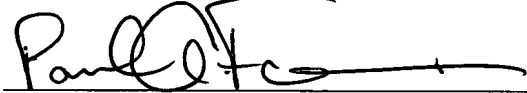
required, including any required extension of time fees, or credit any overpayment to Deposit Account No. 50-0573. This paragraph is intended to be a **CONSTRUCTIVE PETITION FOR EXTENSION OF TIME** in accordance with 37 C.F.R. § 1.136(a)(3).

Respectfully submitted,

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